Effects of capsaicinoids and curcumin on copper-induced oxidation of human serum

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Introduction

Oxidation of low density lipoprotein (LDL) cholesterol is believed to be the first step in the development and progression of atherosclerosis. The susceptibility of LDL to oxidation has been linked to increased atherosclerotic risk and can be assessed *in vitro* by measuring the rate of oxidation of fractionated LDL in the presence of metals such as copper or iron. The active ingredients of spices such as chilli and turmeric (capsaicin and curcumin, respectively) have been shown to reduce the susceptibility of isolated LDL to oxidation. Recent research suggests that *in vitro* tests for oxidation of lipids in unfractionated serum may provide a closer representation to *in vivo* conditions compared to isolated LDL.

Aim

Our aim was to investigate the effects of different concentrations of the antioxidants, capsaicin, dihydrocapsaicin and curcumin on copper-induced oxidation kinetics of lipids in unfractionated serum.

Methods

Serum collected from six fasting healthy individuals (3 men and 3 women, mean ± SD age 34 ± 10 years) was diluted 50-fold in phosphate-buffered saline (pH 7.4), incubated with increasing concentrations (0.1, 0.5, 0.7, 1, 2 and 3µM) of capsaicin, dihydrocapsaicin and curcumin, and subjected to copper (100µM) induced oxidation. Oxidation kinetics were determined for each serum sample in duplicate by measuring absorbance at 245nm at 37◦C using a multi-position spectroscope (Cintra 10E UV-VIS , GBC scientific equipments, Victoria, Australia) every 10 min for 300 min. Lag time (before initiation of oxidation) and rate of oxidation (slope of propagation phase) were calculated from the oxidation curves. Repeated measures ANOVA using general linear modelling (STATA v8.2) was used to test for differences between controls and individual concentrations of capsaicin, dihydrocapsaicin and curcumin.

Results

Lag time increased and rate of oxidation decreased ($p<0.05$) with the increasing concentrations of the antioxidants. A 50% increase in lag time (from control) was observed at concentrations between 0.5 to 0.7µM for capsaicin, dihydrocapsaicin and curcumin. Although the rate of oxidation decreased with increasing concentrations of the tested antioxidants, the total oxidation was lower with capsaicin and dihydrocapsaicin compared to curcumin. At the highest concentration of 3 µM of capsaicin, dihydrocapsaicin and curcumin, the maximum change in absorbance was 72.8%, 75.2% and 65.1% lower than the control respectively.

Conclusion

This study shows that *in vitro* oxidation of serum lipids is significantly reduced by capsaicinoids and curcumin in a concentration-dependent manner. Dietary intake of these antioxidants may lead to a similar dose-dependent reduction in susceptibility to serum lipid oxidation *in vivo*, potentially conferring protective effects on the development and progression of LDL oxidation mediated atherosclerosis.

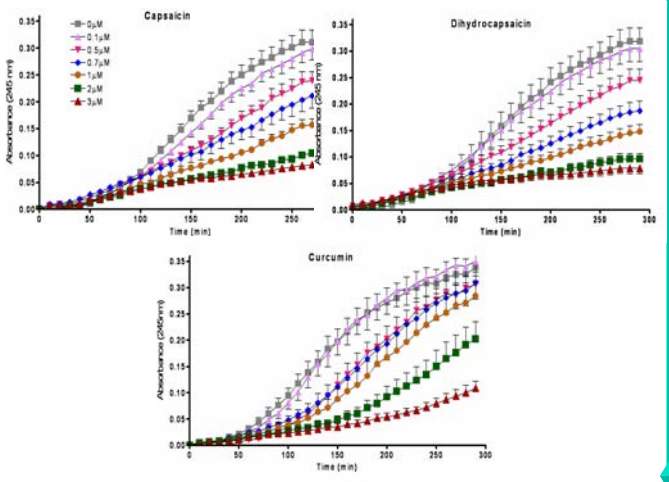

Figure 1. Copper-induced lipid oxidation curves for serum with different concentrations of capsaicin, dihydrocapsaicin and curcumin. Values are shown as mean ± SEM for six duplicate determinations with each concentration of capsaicin, dihydrocapsaicin and curcumin.

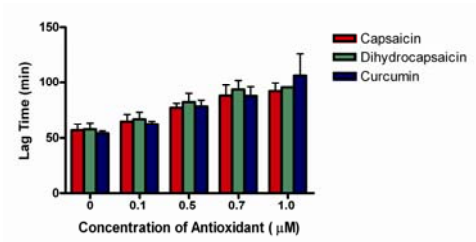

Figure 2. Calculated lag-phase for initiation of serum lipid oxidation calculated from breakpoint of oxidation curves. Values are shown as mean ± SD.

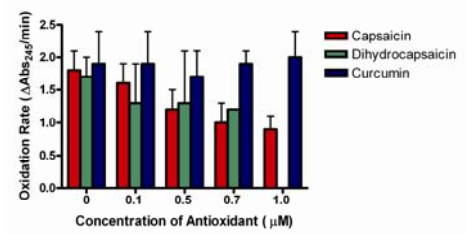

Figure 3. Rate of serum lipid oxidation during propagation phase of reaction calculated from oxidation curves. Values are shown as mean ± SD.

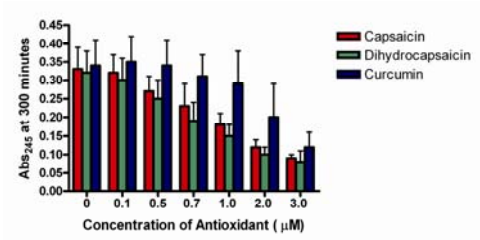

Figure 4. Maximal absorbance change of serum lipid oxidation reaction after 300 min. Values are shown as mean ± SD.